

Abstract of the Invention

Magnetic levitation methods and apparatus use arrays of vehicle magnets to provide three forces: suspension, guidance and propulsion. The magnets, which can be permanent
5 magnets or superconducting magnets operating in the persistent current mode, have associated control coils that allow the magnets to provide a controllable attractive force to a laminated steel rail. The control coils adjust the gap between the magnets and the rails so as to be in stable equilibrium without requiring significant power dissipation in the control coils. These same magnets and steel rails also provide lateral guidance to keep the vehicle on the
10 track and steer the vehicle on turns. The suspension control coils can provide lateral damping by means of offset magnets in the suspension arrays. Windings in transverse slots in the steel rails are excited with currents that react against the field produced by the vehicle magnets to create vehicle propulsion. The magnet size is adjusted to provide negligible cogging force even when there are as few as three winding slots per wavelength along the rail. Means are
15 used to mitigate end effects so that a multiplicity of magnet pods can be used to support the vehicle.

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